(12) UK Patent Application (19) GB (11) 2 163 296 A

(43) Application published 19 Feb 1986

(21) Application No 7833972

(22) Date of filing 19 Aug 1978

(30) Priority data
(31) 3659677 (32) 1 Sep 1977 (33) GB

(51) INT CL⁴
H01F 17/00

(52) Domestic classification
H1Q EJ

(56) Documents cited
GB 1258943 GB 1152431 GB 0585460
GB 1199767 GB 1074894 GB 0581746

(58) Field of search
H4A

(71) Applicant
Elliott Brothers (London) Limited (United Kingdom),
Marconi House, New Street, Chelmsford, Essex
CM1 1PL

(72) Inventor
Ian Hunter

(74) Agent and/or Address for Service
D G Rouse,
Marconi House, New Street, Chelmsford, Essex
CM1 1PL

(54) Reducing radar reflections

(57) To reduce radar reflections from a body its wall is a quarter-wavelengh-thick insulating layer 6 (GRP) between metallic layers 7, 8, the outer layer being partially transmissive.

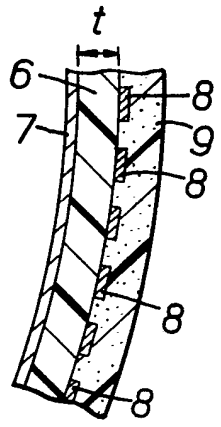

FIG.2.

GB 2 163 296 A

1/1

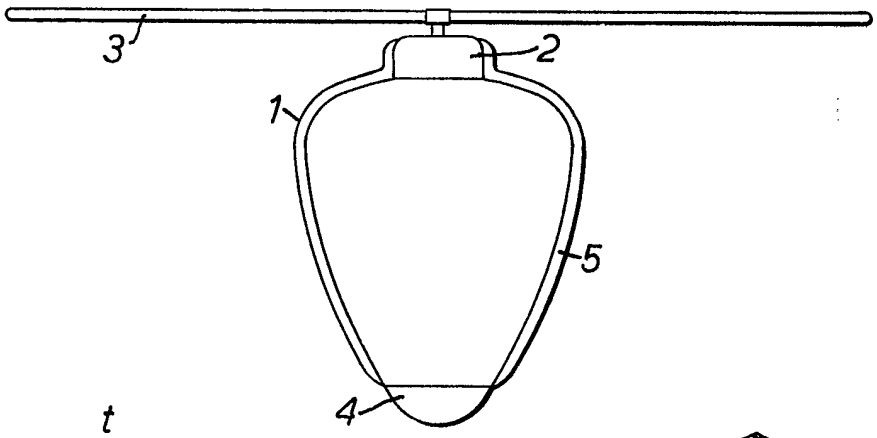

FIG. 1.

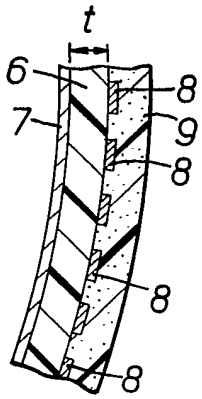

FIG. 2.

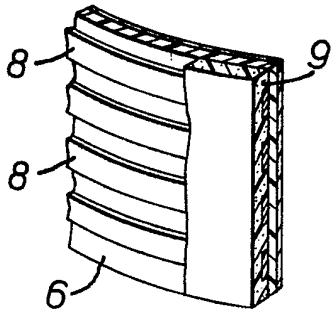

FIG. 3.

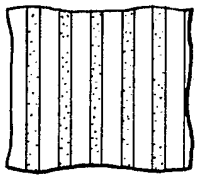

FIG. 4.

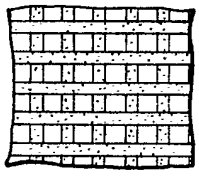

FIG. 5.

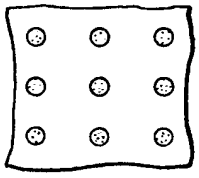

FIG. 6.

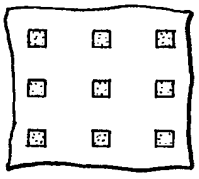

FIG. 7.

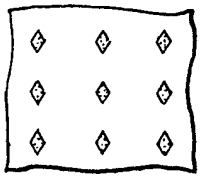

FIG. 8.

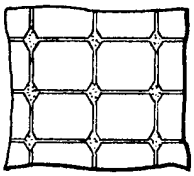

FIG. 9.

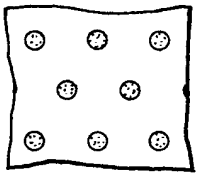

FIG. 10.

SPECIFICATION

Improvements in or relating to bodies of low response to radar beams

This invention relates to bodies, and in particular to flying machines, which are required to provide as little response as possible to a probing radar beam.

Whilst not limited thereto in its application, the invention is particularly applicable to miniature unmanned helicopters provided with surveillance equipment, such as a television apparatus, and the means for transmitting surveillance information back to a control station.

The general configuration of a typical miniature helicopter of the above type is shown in Fig. 1 of the accompanying drawing.

Referring to Fig. 1, the body 1 of the helicopter is formed of glass reinforced plastic and is shaped to provide a small a target as possible both to the eye and to a radar beam. At one end of the body 1 a motor (not shown) typically of 40 horse power is enclosed within a pod 2 and connected to drive rotor blades 3. At the other end of the body 1, the lowermost end when the helicopter is in normal flight, is provided a window area 4 through which the surveillance apparatus views the earth surface over which the helicopter is flying. Radio transmitting apparatus (not shown) is provided to relay surveillance information back to a control station. The principal purpose of such a helicopter is to position itself over enemy lines in order to observe and relay information concerning movement and dispositions within the enemy lines.

As will be appreciated the survival time of such a helicopter in active service depends to a great extent upon the length of time it takes for the enemy to detect it presence and whilst visual detection is not impossible, the main problem concerns detection by a ground radar. It is known to cover the major parts of the outer surface of the body 1 with a layer, represented at 5, of radar absorbing material (RAM), usually of reticulated plastic foam. The use of such material can often reduce the radar return from the surface of the body 1 by up to 16 dB.

The present invention seeks to provide an improved flying machine, and in particular an improved miniature unmanned surveillance helicopter, in which, under some circumstances, a radar return from the surface thereof will be considerably attenuated.

According to this invention in its broadest aspects a body is provided having a wall liable to be presented to a radar beam, at least part of said wall consisting of a layer of insulating material having an inner substantially continuous layer of metal and an outer layer of metal which is semi-transmissive so as to allow passage therethrough of part of said radar beam, said layer of insulating material being of a thickness substantially equal to

$$\frac{\lambda}{4}$$

or an odd multiple thereof, whereby destructive combination occurs of the returns from a radar beam of wavelength λ due to reflections from said inner and outer metal layers.

Whilst said outer layer of metal may be a continuous layer which is semi-transmissive (e.g. 60% transmissive) preferably said outer layer is a patterned layer.

According to this invention in its preferred aspects, a flying machine is provided having a wall liable to be presented to a radar beam, at least part of said wall consisting of a layer of insulating material having an inner substantially continuous layer of metal and an outer layer of metal which is patterned so as to allow passage therethrough of said radar beam, said layer of insulating material being of a thickness substantially equal to

$$\frac{\lambda}{4}$$

or an odd multiple thereof, whereby destructive combination occurs of the returns from a radar beam of wavelength λ due to reflections from said inner and outer metal layers.

Preferably said flying machine is an unmanned miniature helicopter.

Preferably said layer of insulating material is a layer of glass reinforced plastic.

Said outer layer of metal may be provided in any of a number of different patterns. For example, said outer layer of metal may be provided as a pattern of strips, horizontal or vertical with respect to the normal attitude of the helicopter when flying; or a mesh of crossing strips; or a matrix of round elements, interconnected or otherwise, or a matrix of ring shaped elements, interconnected or otherwise; or a matrix of diamond shaped elements, solid or open framed and interconnected or otherwise; or a matrix of squares solid or open framed and interconnected or otherwise.

Preferably a layer of radar absorbing material, R.A.M. as known *per se* is provided to cover said outer metal layer.

The invention is further described with reference to Figs. 2 to 10 of the accompanying drawing in which Fig. 2 is a cross section through part of the wall of the body of an unmanned miniature helicopter in accordance with the present invention.

Fig. 3 is a perspective view of part of the outer wall of the helicopter shown in Fig. 2, and Figs. 4 to 10 illustrate a selection of

other patterns which may be used for the outer metal layer 8 of the wall of the helicopter of Fig. 2.

Referring to Fig. 2 except for the nature of the wall of the body 1 of the helicopter the general construction is similar to that illustrated in the accompanying Fig. 1. The wall consists of a layer 6 of glass reinforced plastic having a thickness t equal to

$$\frac{\lambda}{4},$$

where λ is the wavelength of a known radar to which the helicopter is liable to be exposed during operation. The inner surface of the layer 6 is provided with a continuous layer 7 of metal formed by deposition, or otherwise. The outer surface of the layer 6 is provided with a pattern layer of metal, again formed by deposition or otherwise, the pattern in this case consisting of a series of isolated strips 8.

The outer pattern metal layer formed by the strips 8 is itself covered by a layer 9 of radar absorbing material, in this case reticulated plastic foam. As best seen from Fig. 3, in which part of the outer layer 9 of radar absorbing material has been cut away, the strips 8 in this case extend horizontally with regard to the normal flying attitude of the helicopter.

Referring to Fig. 4, in this case the conductive member layer 8 is provided as a pattern of vertically extending strips.

Referring to Fig. 5, in this case the outer metal layer 8 is provided as a pattern consisting of a mesh of crossing horizontally and vertically extending strips.

Referring to Fig. 6, in this case the outer metal layer 8 is provided as a series of discrete circular elements arranged in a matrix of rows and columns.

Referring to Fig. 7, in this case the outer metal layer 8 is provided as a series of discrete solid square elements arranged in a matrix of rows and columns.

Referring to Fig. 8, in this case the outer metal layer 8 is provided as a series of discrete solid diamond shaped elements arranged in a matrix of rows and columns.

Referring to Fig. 9, in this case the outer metal layer 8 is provided as a series of discrete solid diamond shaped elements arranged in a matrix of rows and columns, in this case interconnected.

Whilst not illustrated, in further modifications the elements of Figs. 6 and 7, are interconnected in a manner similar to that shown for the elements in Fig. 9 and furthermore, in further modifications the individual elements may be open framed, (e.g. rings in the case of Fig. 6). In further modifications, the individual elements are arranged in geometric patterns other than in simple rows and columns, for example, as illustrated in Fig. 10.

CLAIMS

1. A body having a wall liable to be presented to a radar beam, at least part of said wall consisting of a layer of insulating material having an inner substantially continuous layer of metal and an outer layer of metal which is semi-transmissive so as to allow passage therethrough of part of said radar beam, said layer of insulating material being of a thickness substantially equal to

$$\frac{\lambda}{4}$$

or an odd multiple thereof, whereby destructive combination occurs of the returns from a radar beam of wavelength λ due to reflections from said inner and outer metal layers.

2. A body as claimed in claim 1 and wherein said outer layer of metal is a continuous layer which is semi-transmissive.

3. A body as claimed in claim 2 and wherein said outer layer of metal is 60% transmissive.

4. A body as claimed in claim 1 and wherein said outer layer is a patterned layer.

5. A flying machine having a wall liable to be presented to a radar beam, at least part of said wall consisting of a layer of insulating material having an inner substantially continuous layer of metal and an outer layer of metal which is patterned so as to allow passage therethrough of said radar beam, said layer of insulating material being of a thickness substantially equal to

$$\frac{\lambda}{4}$$

or an odd multiple thereof, whereby destructive combination occurs of the returns from a radar beam of wavelength λ due to reflections from said inner and outer metal layers.

6. A flying machine as claimed in claim 5 and wherein said flying machine is an unmanned miniature helicopter.

7. A machine as claimed in claim 5 or 6 and wherein said layer of insulating material is a layer of glass reinforced plastic.

8. A machine as claimed in any of claims 5 to 7 and wherein said outer layer of metal is provided as a pattern of strips, horizontal or vertical with respect to the normal attitude of the helicopter when flying.

9. A machine as claimed in any of claims 5 to 7 and wherein said outer layer of metal is a mesh of crossing strips.

10. A machine as claimed in any of claims 5 to 7 and wherein said outer layer of metal is a matrix of round elements, interconnected or

otherwise.

11. A machine as claimed in any of claims 5 to 7 and wherein said outer layer of metal is a matrix of ring shaped elements, interconnected or otherwise

12. A machine as claimed in any of claims 5 to 7 and wherein said outer layer of metal is a matrix of diamond shaped elements, solid or open framed and interconnected or otherwise.

13. A machine as claimed in any of claims 5 to 7 and wherein said outer layer of metal is a matrix of squares solid or open framed and interconnected or otherwise.

14. A machine as claimed in any of the above claims and wherein a layer of radar absorbing material, R.A.M. as known *per se*, is provided to cover said outer metal layer.

15. An unmanned miniature helicopter substantially as herein described with reference to Figs. 2 and 3 of the accompanying drawing.

CLAIMS

Amendments to the claims have been filed, and have the following effect:–

Claims 1–15 above have been deleted.

New claims have been filed as follows:–

1. A body having a rigid structural wall of insulating material liable to be presented to a radar beam, wherein at least part of said wall is provided with an inner substantially continuous layer of metal and an outer layer of metal which is semi-transmissive so as to allow passage therethrough of part of said radar beam, said at least part of said wall being of a thickness substantially equal to

$$\frac{\lambda}{4}$$

or an odd multiple thereof, whereby destructive combination occurs of the returns from a radar beam of wavelength λ due to reflections from said inner and outer metal layers.

2. A body as claimed in claim 1 and wherein said outer layer of metal is a continuous layer which is semi-transmissive.

3. A body as claimed in claim 2 and wherein said outer layer of metal is 60% transmissive.

4. A body as claimed in claim 1 and wherein said outer layer is a patterned layer.

5. A body as claimed in any of the above claims and wherein said wall is of glass reinforced plastic.

6. A body as claimed in any of the above claims and in the form of a flying machine.

7. A body as claimed in claim 6 and in the form of an unmanned miniature helicopter.

8. A body as claimed in claim 7 and wherein said outer layer of metal is provided as a pattern of strips, horizontal or vertical with respect to the normal attitude of the helicopter when flying.

9. A body as claimed in any of the above claims and wherein said outer layer of metal is a mesh of crossing strips.

10. A body as claimed in any of the above claims 1 to 8 and wherein said outer layer of metal is a matrix of round elements, interconnected or otherwise.

11. A body as claimed in any of the above claims 1 to 8 and wherein said outer layer of metal is a matrix of ring shaped elements, interconnected or otherwise.

12. A body as claimed in any of the above claims 1 to 8 and wherein said outer layer of metal is a matrix of diamond shaped elements, solid or open framed and interconnected or otherwise.

13. A body as claimed in any of the above claims 1 to 8 and wherein said outer layer of metal is a matrix of squares solid or open framed and interconnected or otherwise.

14. A body as claimed in any of the above claims and wherein a layer of radar absorbing material (R.A.M.) is provided to cover said outer metal layer.

15. An unmanned miniature helicopter substantially as herein described with reference to Figs. 2 and 3 of the accompanying drawing.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1986, 4235.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.